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RESEARCH ARTICLE

Impact of seasonal fluctuation on phytoplankton diversity in fresh water lake of Arekurahatti in Navalgund of Dharwad

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SUMMARY : Physico-chemical analysis is considered to be the main feature to assess the quality of water for its best utilization for drinking and irrigation. There is a need to understand the interaction between climatic and biological processes in the water. In the present investigation, the monthly variation in different physico-chemical characteristics like pH, temperature, electric conductivity, alkalinity etc. were analyzed from May 2012 to April 2013, to know the water quality and impact of seasonal fluctuation on phytoplanktons in Arekurahatti lake of Navalgund Taluk. The surface water samples from fixed spots were collected and analyzed at an interval of one month for a period of 12 months. The results revealed that the variations in pH, temperature and other physico-chemical parameters played an important role in the phytoplankton distribution in different seasons. Therefore, it can be concluded that Arekurahatti lake water can be used only for domestic purposes and not for consumption. It was also found that there was rich diversity of phytoplanktons especially Cyanophyceae and Bacillariophyceae members.

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Key Words :
Phytoplankton diversity, Seasonal fluctuation, Physico-chemical features, Arekurahatti lake

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Water is nature's most essential gift to man, which keeps him alive, by meeting the basic necessities of the smaller living unit cell. Availability of potable water of acceptable quality in nature is becoming rare day by day, especially in rural area. Water pollution has reached alarming proportion in the recent years. Pollutants bring about physical, chemical and biological changes and make the water unfit for drinking and harmful to aquatic life. In India, lakes, rivers and other freshwaters support a large diversity of biota representing almost all taxonomic groups. Algae in open waters represent the floristic diversity and macrophytes dominate the wetlands. It is difficult to analyze the algal diversity in many lakes with reference to different habitats endemicity to India, as well as the seasonal variations and anthropogenic disturbances. Water quality is directly proportional to the human population and its various activities. More than 50,000 small and large lakes are polluted to the point of being considered dead. Various phytoplankton groups prefer to exist in various kinds of water. In each group, there may be certain species which resist pollution while others may be very sensitive.

Many workers such as Rao (1975), Bharathi and Hosamani (1975), Palidebnath and Mukherjee (2011), Hosmani (1975), Hosmani *et al.* (2011), Venkataramaiah (2011) have published their work on environment and ecology of phytoplanktons in fresh water in different lakes of our subcontinent. Fresh water lakes play a vital role in hydro-biological, biological and bio-geochemical aspects of the environment. Therefore, the management and the practices must be integrated on the basis of ecological values and sustainability to create long term vision. Thus, the present study was undertaken to know the diversity of phytoplanktons in different seasons in highly disturbed fresh water body of Navalgund, where people use it for drinking and domestic purposes.

EXPERIMENTAL METHODOLOGY

Navalgund is a taluka which comes under Dharwad district, Karnataka state, India. It is located 47 kms away from Dharwad and 374 kms from Bangalore. Geographically it is situated in between latitude 15° 34' 0, 120" N longitude 75° 22' 0, 120" E and altitude 1896 feet (578 m). Approximate population for 7 km radius from this point 37443. Winter temperature 20°C, summer temperature 39 °C. Arekurahatti lake is large sized lake (14 acres) situated in the village Arekurahatti.

Water samples were collected for the estimation of physico-chemical parameters from the Arekurahatti lake of Navalgund taluk for a period of twelve months from May 2012 to April 2013 at an interval of one month. The samples were collected in pre-cleaned polyethylene carbonyl cans of one litre with necessary precautions and utmost care (APHA, 1995). Samples were brought to the laboratory to study their physical and chemical parameters. Winklerization was made in separate 300 ml BOD bottles for the estimation of dissolved oxygen. From the collected sample of the lentic water body, sedimentation was made in acid Lugol's solution and the supernatant was discarded. The phytoplankton sediment was concentrated to 30 ml by centrifugation. Micro photographs were taken by using high resolution microscope.

EXPERIMENTAL FINDINGS AND DISCUSSION

The results of the physico-chemical analysis of Arekurahatti lake is presented in Table 1. pH is an important quality parameter which influences the survival and nourishment of biological life. Maximum pH value was observed in the month of August and September because of less rain fall with hot sunny days and lowest pH value in the month of January in Arekurahatti lake (Table 1).

It has been well documented that the variation in water temperature can be correlated with seasonal variation. The water was comparatively warmer in the May and April months as because of the less rain fall and hot sunny days. The temperature reduced to 20°C in the month of January (during winter season). Electric conductivity (EC) was varying from the minimum 220µs/cm to maximum of 330µs/cm in Arekurahatti lake. In the present study, alkalinity was increased in the month of October and very least in the month of May. Turbidity was acceptable only in the month of May in Arekurahatti Lake (WHO, 1990). Total dissolved solids (TDS) were high in the month of May and April and low in the month of November and February in Arekurahatti lake (Fig. 1).

Calcium was found high in the month of February. Total hardness and magnesium was found high in the month of January. But total hardness, calcium and magnesium were found minimum in the month of May. Sodium and sulphates were found high in the month of September and these were found minimum in the month of December and March. Chloride and nitrate were found maximum in the month of June and minimum in the month of April and September, respectively.

Table 1 : Analysis of physico-chemical parameters in Arekurahatti lake (May-2012 to April-2013)

Parameter/months	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
pH	8.5	8.4	8.6	8.7	8.7	8.2	8.5	8.2	7.7	7.9	8.3	8.4
Temperature^0 C	29^{0}C	26^{0}C	27^{0}C	28^{0}C	28^{0}C	28^{0}C	24^{0}C	24^{0}C	20^{0}C	24^{0}C	28^{0}C	29^{0}C
EC µs/cm	330	300	250	300	310	260	220	230	240	220	290	330
Alkalinity mg/l	2.7	2.7	5.6	6	4.4	6.92	5.6	4	5.6	5.2	2.8	4.12
Turbidity NTU	5.1	10	27	54	82	12	2.8	3.5	4.5	6.4	3	6
TDS mg/l	170	154	128	154	159	133	112	117	123	112	149	170
Calcium mg/l	40	48	106	146	80	100	80	140	140	180	58	60
Magnesium mg/l	12.15	20.9	6.32	37.42	35.47	56.37	29.16	30.62	68.04	14.58	14.1	12.64
Total hardness mg/l	90	134	132	300	226	332	200	266	420	240	116	112
Potassium mg/l	1.8	1.8	1.7	3.2	2.9	3.1	2	2	2.5	1.9	2.5	1.5
Sodium mg/l	45	25	24	45	52.5	49	26	20	38	30	35	40
Total phosphates mg/l	10.8	6.4	5.7	6.3	5.9	6.4	5.9	2.8	1.7	1.6	1.8	0.71
Chloride mg/l	32	52	38	38	39.2	38	44	34.6	38	36	30	22
Sulphate mg/l	10	8	7.5	12.6	14.4	5.4	10.5	11.7	2.9	7.9	2.8	4
Nitrates mg/l	0.6	1.8	0.4	0.6	0.1	0.8	1.5	1.4	0.9	0.7	0.3	0.4
Dissolved oxygen mg/l	5.8	6.6	6.8	6.5	7	7	9	7	6	7	6.5	6.2
Chemical oxygen demand mg/l	73.6	22.4	16	19.2	25.6	32	28	28	30	31	15.7	37.3
Biological oxygen demand mg/l	1.6	6.6	5.6	2.5	2.1	2.0	5.0	0	2.3	3.7	5.2	0.003

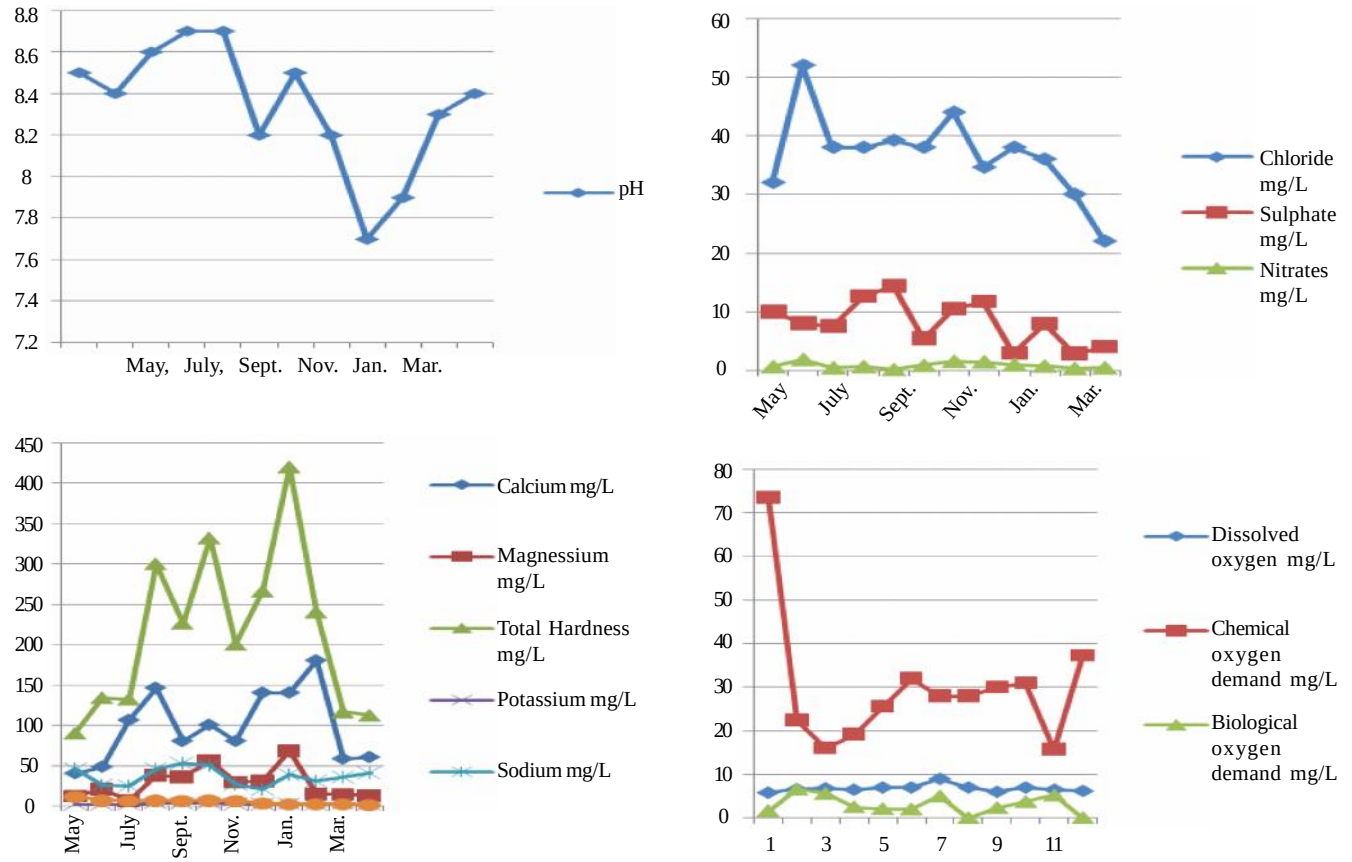

Fig. 1 : Monthly changes in physico-chemical parameters of Arekurahatti lake in Navalgund, Dharwad district, Karnataka (May-2012 to April 2013)

Nitrates, sulphates and chlorides play an important role in the eutrophication (Meera Bai and Ranjit, 2010). In the present study, sulphates and nitrates were found within the desirable range (WHO, 1990). Total Phosphate and COD were found high in the month of May and least in the month of April and March, respectively. Potassium was found maximum in the month of August and minimum in the month of July. BOD values were found maximum in the month of June and least in the month of December.

Dissolved oxygen plays an important role in regulating inside waters. DO was higher in the months of November and lower in month of May. Chemical oxygen demand is the amount of oxygen required for oxidation of organic constituents with strong oxidizing agent (acidified potassium dichromate). Thus, it is used as measure of organic equivalent of the organic matter present in the sample. The COD values varied from 16.0 to 73.6 mg/l in. It showed the organic load pollution in the lake. The values obtained are not acceptable according to drinking water quality standards (WHO, 1990). High values of total alkalinity may be attributed to the increase in organic decomposition during which carbon dioxide is liberated. This reacts to form bicarbonate thereby increasing total alkalinity in summer (Mahadev *et al.*, 2010). Total alkalinity is due to salts of weak acids and bicarbonates .The highly alkaline water is not potable. Chloride concentration is the most useful parameter for evaluating the atmospheric input to sub-surface water (Shiva Kumar *et al.*, 2009). High concentration of chloride in the water gives an undesirable taste to water. This higher concentration of chloride reduced the algal population in the present work.

The seasonal variation in total phytoplankton number was due to various factors such as temperature, intensity of light, bicarbonates and organic matter. Certain plankton population apparently disappears at a specified period and reappears during the other period. This disappearance may be due to the fact that some species either become to scare or occur in spores, which cannot be easily detected. However, on the return of favourable conditions, spore again germinates and planktons appear. It is also observed that some species which are present in less abundance during some months reappear during other months when the conditions become favourable.

The peaks of phytoplankton occur at different periods in different years. Therefore, only temperature was not

responsible for the fluctuation in numbers but high pH, alkalinity, carbon dioxide and nutrients are also responsible for their organic production. The phytoplankton population is rich in fertile water. Phosphorus is another factor that deviated considerably in the lake waters. Phosphates are common inside cells but can be excreted outside the cell or be associated with the exterior cell surface. Phosphatase enzymes cleave dissolved organic phosphorus to liberate phosphate. Excretion of extracellular phosphates increases when phosphorus becomes scarce. The ubiquitous nature of these compounds in lakes leads to rapid turnover of many organic phosphorus compounds leading to high amounts of phosphorus in lakes.

Chloride concentration is the not useful parameters for evaluating the atmosphere input to subsurface water (Shivkumar *et al.*, 2009). High concentration of chloride in the water gives an undesirable taste to water. The chloride content varied from 22.0 mg/l to 52.0 mg/l. These values found in the Arekurahatti lake were within the acceptable range.

Infact in the present study, temperature, pH, alkalinity and nutrient content in Arekurahatti lake water played a vital role. During the investigation, phytoplankton distribution varied in different seasons between May 2012 to April 2013. Similar findings were reported by Mahadev *et al.* (2010). Dissolved oxygen (5.8mg/l to 9.0mg/l) content and BOD (0.0mg/l to 6.6mg/l) in Arekurahatti lake fluctuated much and always deviated from prescribed limits having a positive effect in changing the phytoplankton habitat (Hosamani *et al.*, 2011).

Dissolved oxygen, phosphate, nitrate and pH are the most significant parameters operating in this water body.

Table 2 : Impact of seasonal fluctuation on phytoplanktons distribution

Year-2012-2013
Monsoon
Cyanophyceae>Bacillariophyceae > Chlorophyceae > Euglenophyceae
Winter
Bacillariophyceae>Cyanophyceae > Euglenophyceae > Chlorophyceae
Summer
Bacillariophyceae>Cyanophyceae > Chlorophyceae > Euglenophyceae

Table 3 : Distribution of some important phytoplanktons of Arekurahatti lake

Year-2012-2013	
I.	**Cyanophyceae members**
	Anabaena sp.
	Merismopedia glauca
II.	**Chlorophyceae members**
	Closterium sp.
	Netrium sp.
	Selenastrum gracile
III.	**Bacillariophyceae members**
	Rhopalodia gibba
	Gyrosigma scalproides
	Cocconeis pediculus
	Navicula grimmei
	Navicula brasilience
IV.	**Euglenophyceae members**
	Euglena oxyuris

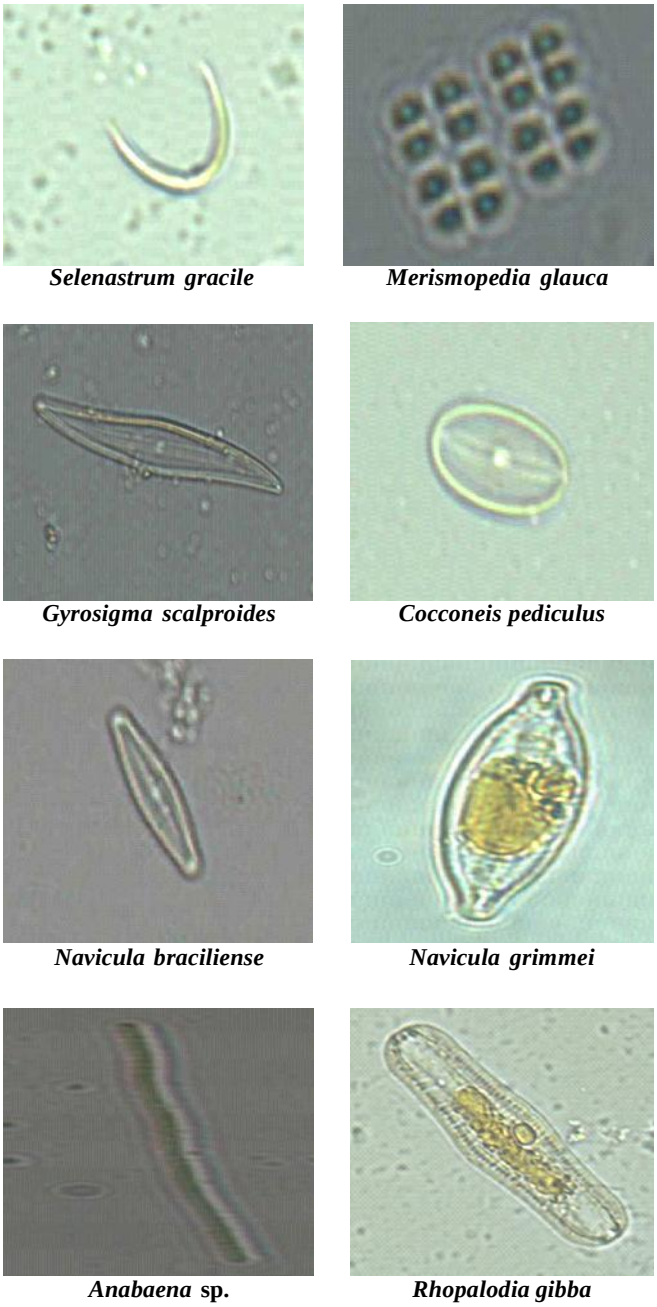

Plate 1 : Microphotographs of some important phytoplanktons in Arekurahatti lake

High alkaline nature of water decreased the number of Cyanophyceae, Chlorophyceae and Euglenophyceae mumbers. Calcium deficiency may be a important factor, which influenced the abundance of Bacillariophyceae members. Bacillariphyceae members are dominant over other members of Cyanophyceae and Chlorophyceae (Table 2 and 3).The investigation may suggest that the water of Arekurhatti lake may be used for domestic purposes but not for drinking/ consumption according to drinking water quality standards (WHO, 1990).

Eight phytoplanktons which were found dominant have been presented with microphotographs (Plate 1).

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